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EVALUATING THE PERFORMANCE AND EMISSION CHARACTERISTICS OF CI ENGINE WITH WASTE PLASTIC OIL

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ABSTRACT

The continuous increase of demand for energy, diminution of oil recourses and stringent pollution norms encourage the researchers to find alternate fuels. Waste converted to fuel, a technique to get alternate fuels is an upcoming research. Waste plastic converted to liquid fuel is another alternate energy source path, which can contribute to depletion of fossil fuels and to help avoiding landfills. Performance and emission characteristics of a diesel engine fuelled with waste plastic oil were investigated. Diesel was replaced by various percentages of 10, 20, and 30% by volume with waste plastic oil. From the obtained results, observed the improvement in brake thermal efficiency (Bthe) and reduction in HC and CO emissions for waste plastic oil. Waste plastic oil 30 (W30) showed 11% higher Bthe than the pure diesel operation.

KEYWORDS: Emission Characteristics, CI Engine & Waste Plastic Oil

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Original Article

1. INTRODUCTION

Energy plays a key role in the economic growth of any country and also to the victuals of any modern economy[1]. Diesel engines are higher fuel to power ratio than the gasoline engines[2]. Due to this the utilization of diesel engines, in medium and heavy duty vehicles and in many other fields for various purposes[3]. Waste plastics recycling, regenerating, and utilizing have become a hot spot of research at home and abroad and progressively formed a new industry. These plastics are employed in entire scope of industrial and domestic areas; hence, plastics have become essential materials and their applications in the industrial field are constantly increasing[5]. Recycling of waste plastics is expected to become the most effective way. The Pyrolysis of polyethylene has been deliberated by various authors, and the oil composition results propose that, it is promising fuel for power and heat generation[7].

2. MATERIALS AND EXPERIMENTAL PROCEDURE

2.1 Waste Plastic Oil

Polyethylene is basically categorised into two types: low density polyethylene and high density polyethylene. Generally, most of the plastics have been very low deprivation rate due to the molecular bonds of carbon, hydrogen and some other elements. It makes them extremely durable resulting in a higher environmental issue by land filling them. However, waste plastics can become a source of enormous energy with the correct

treatment[8]. There are basically two recycling process: mechanical, chemical.

2.2 Experimental Setup

In the present investigation, four-stroke single cylinder water cooled diesel engine setup has been used. This setup contains a computer interface for getting the automated data. It is connected with AVL DI gas analyzer for analyzing the emissions like CO, CO_2, NO_X, HC, and O_2. Smoke was measured by using the AVL smoke meter. The engine setup was connected with crank angle encoder and a pressure transducer for the pressure analyzing. The research engine setup was shown in Figure 1.

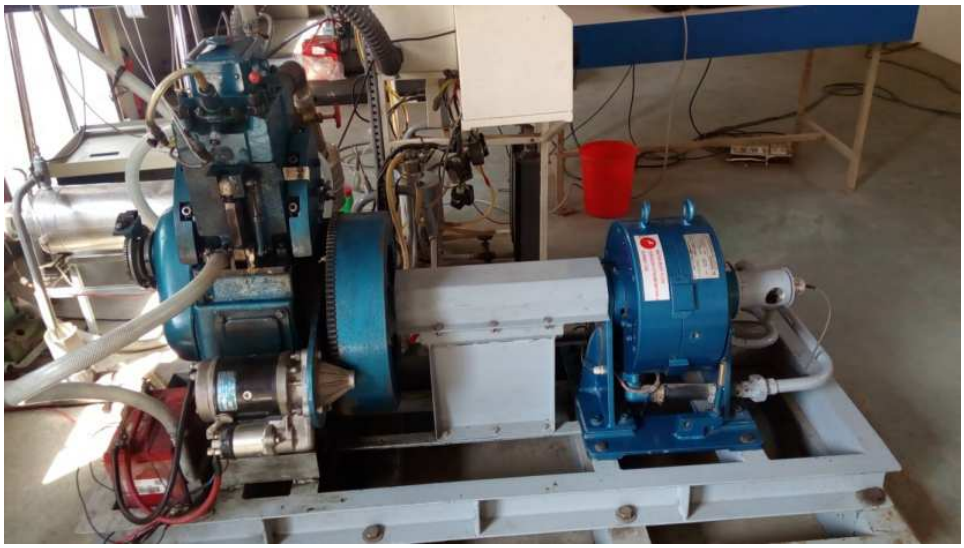


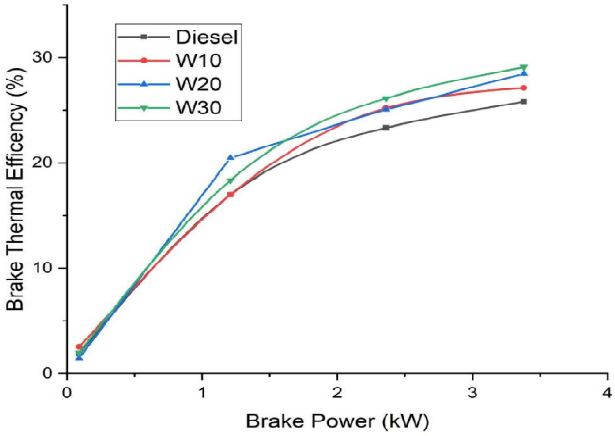
Figure 1: Research Engine Setup

3. RESULTS AND DISCUSSIONS

The experimental investigation was carried out on a single cylinder diesel engine fuelled with waste plastic oil. In the present section, the performance, emission characteristics of diesel engine are deliberated.

3.1 Brake Thermal Efficiency (B_{the})

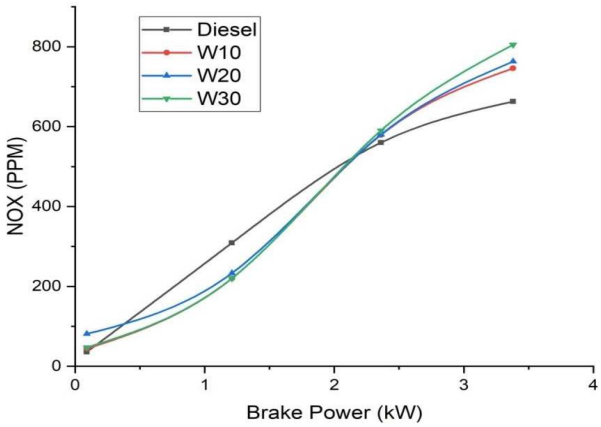
B_{the} is the significance of fuel consumption to useful power generation. It is one of the important performance parameter, which indicates the percentage of energy present in the fuel that is converted into useful work. The variation of brake thermal efficiency at full load for diesel and WPO blends is shown in Graph 1. From the obtained results, observed the improvement in B_{the} for waste plastic oil. Waste plastic oil 30 (W30) showed 11% higher B_{the} when compared to the pure diesel operation.



Graph 1: Brake Power Vs Brake Thermal Efficiency

3.2 Oxides of Nitrogen (NO_X)

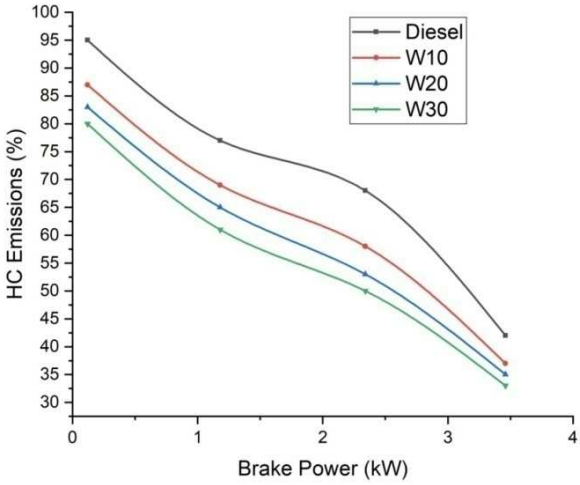
NO_X is formed due to the higher combustion in the combustion chamber. Graph 2 depicts the influence of brake power to the NO_X emissions. NO_X emissions are increased with increase of load. The waste plastics oil blends shown the increase of NO_X emissions when compared with the pure diesel operation. W30 showed 46.15% higher NO_X emissions than the pure diesel.



Graph 2: Brake Power Vs NO_X Emissions

3.3 HC Emissions

Hydrocarbon emissions are formed mainly due to the improper combustion of fuel[9]. Hydrocarbons remain unburned in these areas, because the flame does not wholly propagate into these areas. Graph 3 showed the effect of waste plastic oil blends on HC emissions. From the graph, observed the reduction of HC emissions while increasing the load. The waste plastic oil blends shown the reduction HC emissions when compared with the pure diesel operation. The W30 showed 21.42% reduction of HC than the pure diesel.



Graph 3: Brake Power Vs HC Emissions

4. CONCLUSIONS

In this present experimental investigation, diesel engine was fuelled with waste plastic oil blends. The diesel was replaced by 10, 20, and 30% volume of waste plastic oil. It is represented as W10, W20, and W30. From the obtained results, drawn are the following conclusions.

The brake thermal efficiency of waste plastic oil blends shown higher when compared to the pure diesel. The B_{the} was increased with increase of waste plastic oil percentage. W20 and W30 shown similar B_{the} and W30 showed 11% higher B_{the} when compared to the pure diesel operation. When compared to waste plastics, oil blends shown the increase of NO_X emissions in comparison with the pure diesel operation process. Here, W30 blends showed 46.15% higher NO_X emissions than the pure diesel path. The waste plastic oil blends indicate reduces the HC emissions when compared to pure diesel operation. By observing, the blends of W30 showed 21.42% decreasing in HC emissions and when compared to the pure diesel.

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